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## Lab Report #6: Tangibly understanding intangible complexities: Designing for distributed autonomous organizations

**Bettina Nissen, Ella Tallyn and Kate Symons**

### **Abstract**

New digital technologies such as Blockchain and smart contracting are rapidly changing the face of value exchange, and present new opportunities and challenges for designers.

Designers and data specialists are at the forefront of exploring new ways of exchanging value, using Blockchain, cryptocurrencies, smart contracting and the direct exchanges between things made possible by the Internet of Things (Tallyn et al. 2018; Pschetz et al. 2019). For researchers and designers in areas of Human Computer Interaction (HCI) and Interaction Design to better understand and explore the implications of these emerging and future technologies as Distributed Autonomous Organisations (DAOs) we delivered a workshop at the ACM conference *Designing Interactive Systems (DIS)* in Edinburgh in 2017 (Nissen et al. 2017). The workshop aimed to use the lens of DAOs to introduce the principle that products and services may soon be owned and managed collectively and not by one person or authority, thus challenging traditional concepts of ownership and power. This workshop builds on established HCI research exploring the role of technology in financial interactions and designing for the rapidly changing world of technology and value exchange (Kaye et al. 2014; Malmborg et al. 2015; Millen et al. 2015; Vines et al. 2014). Beyond this, the HCI community has started to explore these technologies beyond issues of finance, money and collaborative practice, focusing on the implications of these emerging but rapidly ascending distributed systems in more applied contexts (Elsden et al. 2018a). By bringing together designers and researchers with different experiences and knowledge of

distributed systems, the aim of this workshop was two-fold. First, to further understand, develop and critique these new forms of distributed power and ownership and second, to practically explore how to design interactive products and services that enable, challenge or disrupt existing and emerging models.

### **Keywords**

Blockchain, smart contracts, distributed autonomous organizations, data physicalization, material mapping

### **Considering distributed autonomous topics**

While the DAOs terminology may seem evasive in its multiple uses, we consider the term to refer to organizations and business models that are underpinned by smart contracts and distributed ledgers, operating somewhat autonomously. These novel technologies mean that concepts of value and value exchange are being challenged in a variety of ways, and, far from being neutral, these innovations are entangled with and are co-producing novel political, economic, social and material arrangements (Kinsley 2014), raising questions of ethics, privacy and the socio-political implications of new forms of distributed authority. The fast-moving industry and research agenda provides an opportunity for designers and HCI researchers to question these novel assemblages both conceptually and in practice. The emergence of DAOs raises questions in many areas, inviting us to rethink current practices of ownership, value and ethical relationships and to reconsider 'value constellations' (Speed and Maxwell 2015) not as independent businesses but entangled networks of people, services and things.

As a novel workshop offering interaction designers a platform to consider the implications of designing for a DAO, the main purpose of the workshop was to deepen our presently limited understanding of this rapidly emerging technology to better understand what DAOs are, and how the data and transactions that occur between and with them might be a material for design. This will also expand our understanding of the ways in which DAOs may stimulate new social and commercial relationships that involve novel forms of design, manufacture and user engagement with data. To tackle these broad topics and issues, we have focused the workshop on three key topics as guiding perspectives for our exploration:

1. *Defining and designing for DAOs:* The concepts of value and value exchange raise several interesting questions for designers. There is an existing body of work in HCI that has studied issues of the exchange of money between individuals and organizations (e.g. Carroll and Bellotti 2015); however, little of this work addresses DAOs directly.
2. *Ownership, power and governance:* Central to the conceptual drivers to the workshop is the shift in concepts and practices raised by DAOs. The fact that DAOs are autonomous (and, we will also question what 'autonomous' means in this context) raises questions of responsibility, ownership and power, in particular, what kinds of power relations do DAOs embody and reproduce, and what changes in conventional power relations are brought about by peer-to-peer, autonomous exchange. Similarly, questions are raised around the governance of DAOs, which may transgress conventional notions of business ownership.

3. *Agency, materiality and politics*: The concept of DAOs is also speaking to contemporary questions of the agency of things. Political theorists such as Jane Bennett encourage us to consider ‘a world populated by animate things rather than passive objects’, and made up of webs of complex and relational forces (2010: i), where a variety of objects and assemblages shape the world alongside the conventionally imagined conscious human agent. We want to question how DAOs might fit into this relational more-than-human ontology of people, things, data and ecologies, and use them as a lens to further advance our understanding of the world as shaped by animate and lively things.

Overall, this workshop offered an opportunity both to collect the diverse range of current and emerging work from the design and research community in this field while offering a space for peer debate and critique surrounding the practices and developments of distributed ledgers, blockchain technology and smart contracts.

### **Tangible mapping of a distributed system**

To explore this emerging field of distributed systems, its opportunities and challenges with a diverse range of researchers from varied backgrounds, we devised a set of tangible materials to collaboratively represent and discuss the entangled relationships between people, organizations, code and things. This material practice is building on an expanding field of research in design and HCI of participatory design (Björgvinsson et al. 2012), material engagement (Malafouris 2013) and data physicalization (Jansen et al. 2015; Hogan et al.

2017). In participatory activities, making has long played a key role in engaging lay audiences through hands-on, accessible and embodied interactions with abstract concepts or critical thinking (Ratto 2011). Moreover drawing on craft, design and making practices HCI has increasingly accepted the shared, performed and enacted nature of making and embraced its role for new ways of thinking through materials to embody data, complex systems or invisible technological concepts (Aguirre and Paulsen 2017). For example, in the context of blockchain technology Lego has been explored as a metaphor to represent the concept of storing transactions in blocks (Maxwell et al. 2015). This hands-on approach offers opportunities to physically visualize different understandings and perceptions of increasingly complex and abstract technological systems. In particular, tangible materials provide an accessible space for collaborative mapping and shared understanding of systems and their relationships. For example, tangible explorations for collaborative mapping of and designs include areas of healthcare services (Rygh 2018), perceptions of energy (Bowden et al. 2015), visitor engagement (Nissen et al. 2014) and experiences of social networks (Fass 2016).

With the aim of this workshop to collaboratively and critically debate the design of such distributed autonomous systems, we used this method for tangibly mapping system structures as participatory activity and explorative design exercise to develop concepts for applied uses of distributed systems. In addition, a secondary aim of the workshop was to explore questions around the value of material qualities in the shared mapping and design processes – How important are the material choices and qualities in the mapping of diverse relationships? What is the value of material engagement for the shared mapping and collaborative design of distributed autonomous systems?

The prepared design and mapping activities took these considerations into account: first, to create adjustable/movable map of different stakeholders using magnetic pins on a magnetic whiteboard sheet that would treat people, organizations and things as equal nodes in a network and second, the choice of materials was considered carefully in its relevance and possibilities to represent varying types of relationships in a distributed system. More specifically, the colours, texture, origin and nature of the materials were considered to potentially represent relationships. We especially considered relationships relevant to DAOs and relationships between people, things and code and aimed to use materials alongside traditional use of wool and string that could represent more specific relationships that may be hard-coded (wire), transparent (fishing line), natural (cotton), entangled (meshes), deteriorating or dissolving (edible shoelaces) in their nature. This adjustable and varied approach with different-coloured pins and materials aimed to allow participants to easily move nodes, stakeholders or entities within their network, annotate these with pens or post it notes and draw connections both visually and materially to represent diverse relationships within the context of their design for a distributed autonomous system.

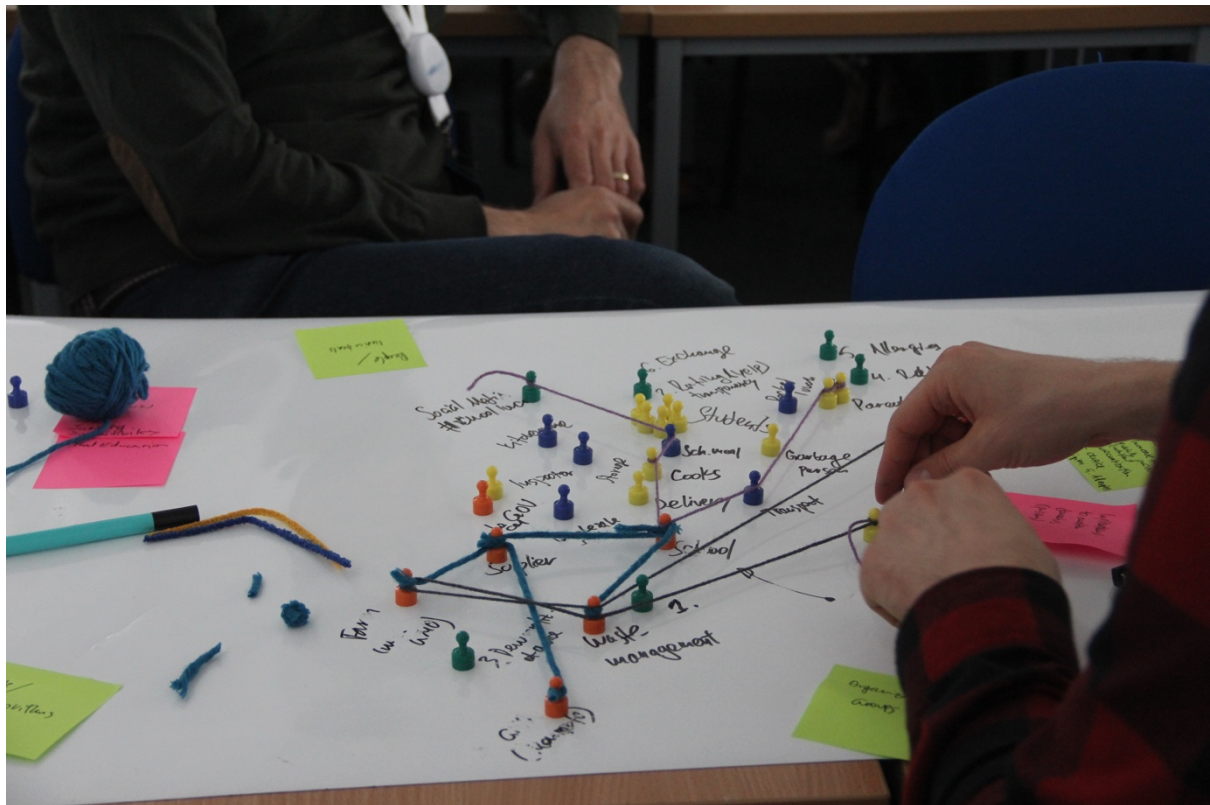


**Figure 1:** Materials and magnetic pins used to map a distributed network.

### Emerging distributed system propositions

After initial sharing of related blockchain and ledger projects, directions and perspectives, participants of the workshop formed groups of three–five people to further investigate interesting topics with relevant potential for a distributed autonomous system. The groups jointly directed and decided their area of enquiry and which topic or area held value to investigate. The workshop activity was structured into two steps, first to consider the entities within such a network, i.e. things, code, organizations and people and second to discuss the relationships between these entities. Over the course of the workshop the four groups of participants discussed and designed distributed networks for areas such as housing, food supply chains, artists’ cooperatives and Internet of Things.

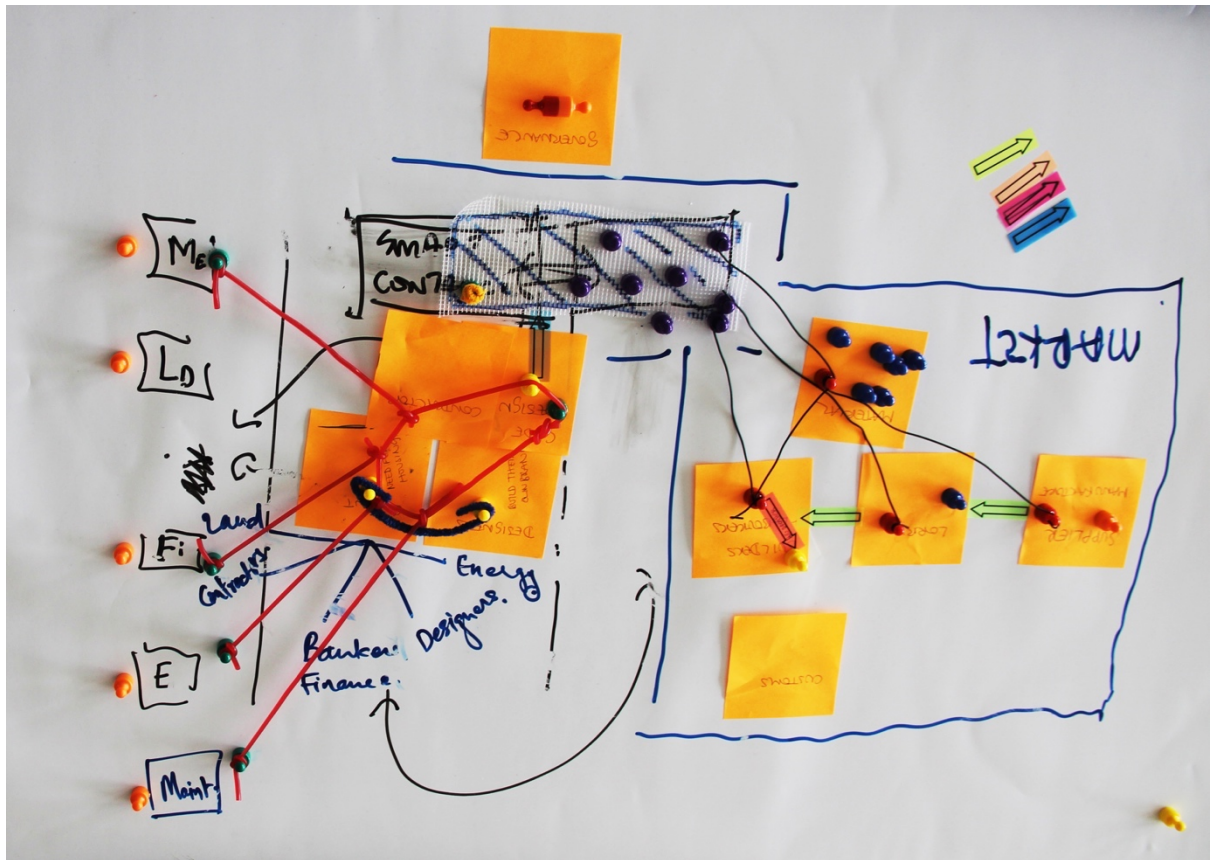




**Figure 2:** One group mapping relationships of their system.

### Distributed autonomous housing

The distributed network for a *Housing DAO* included entities such as clients, contractors, service providers, architects, manufacturers and councils who, as partners, all own stakes in the product (the housing) but the product belongs to itself, with partners forming smart contracts with instances of a product. Issues raised during by this group focused on the tension between immutability of smart contracts and necessity for responsiveness to adapt to required changes of the distributed network. Human actors are dynamic operators of the network and stand in contrast with the fixed nature of smart contracts. There is potential here to redefine the terminology around smart contracts to support adaptive blockchain systems flexible enough for dynamic human interaction as the main operation of a continuously evolving DAO rather than its current model of a fixed programmed system.



**Figure 3:** Mapping of smart contracts for a distributed housing market.

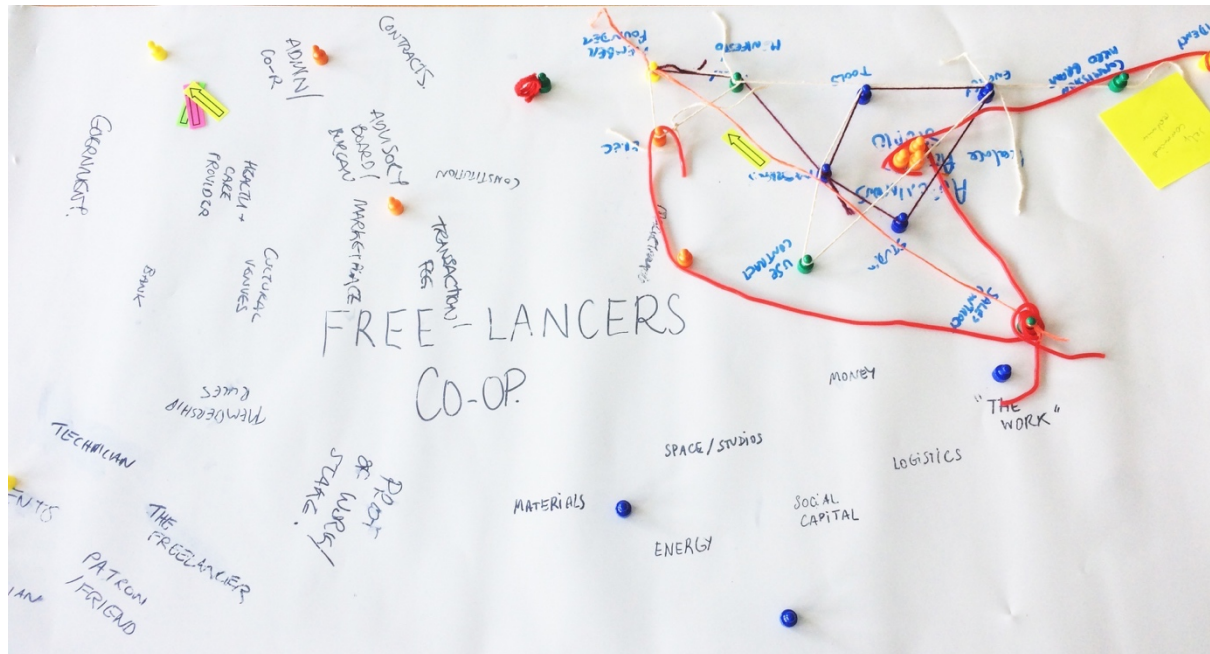
### Distributed school meal supply chains

The DAO exploration in the area of food supply chain focused on the supply of school meals with transactional layers of resources, food, people and organizations offering potential for algorithmically governing ethical, health and sustainability considerations for environment and people. Questions emerging from the discussions in this group were focusing on challenges in relation to the interoperability of a DAO between things, people and organizations and the potential possibilities that could allow for more connected ethical supply chains. However, in such food-related DAOs, concerns about the representation of living things emerged as well that in turn raised questions about the boundary of a specific





balance of power. Questions raised were predominantly centred around how disagreement may be resolved in a distributed system without a traditionally common executive power and who would be able to make decisions if conflict within the network arises.

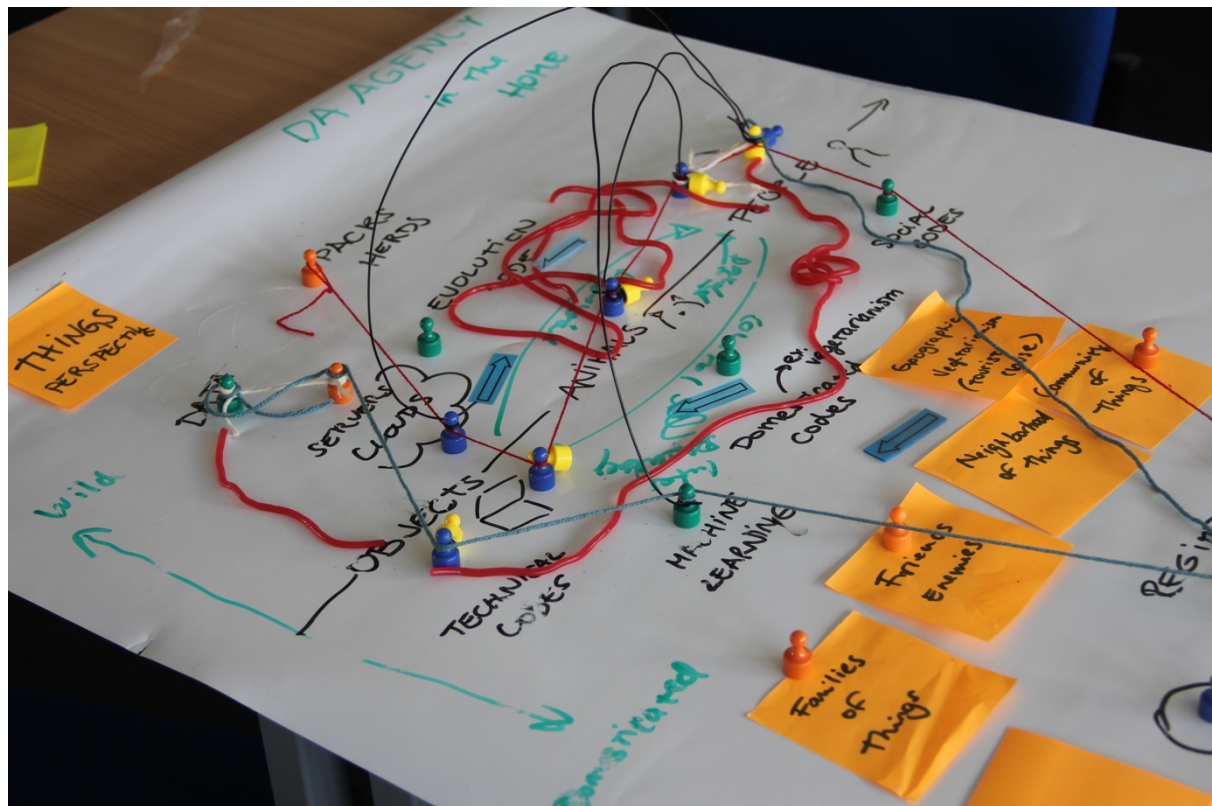


**Figure 5:** Mapping of a distributed cooperative of freelance artists.

### Internet of autonomous things

This group was mapping a continuum of objects, people, control, dependencies and interdependencies in the context of the Internet of Things in the home. Considering code as social, evolutionary and technological structures this group discussed the coded behaviour of IoT devices in the home on a gradual scale from wild to domesticated objects, discussing the agency of the devices, animals and people more linked to each other than traditional computing systems account for, thus questioning the agency and evolution of code and encoded behaviours not only of devices. The interplay of stepping into and out of a technological system in this entangled system helps us better understand the increasing complexity of digital society as a whole that DAOs need to be developed for. Living with

DAOs is about living with multiple smart contracts and varied affiliations with DAOs in their diverse instantiations.

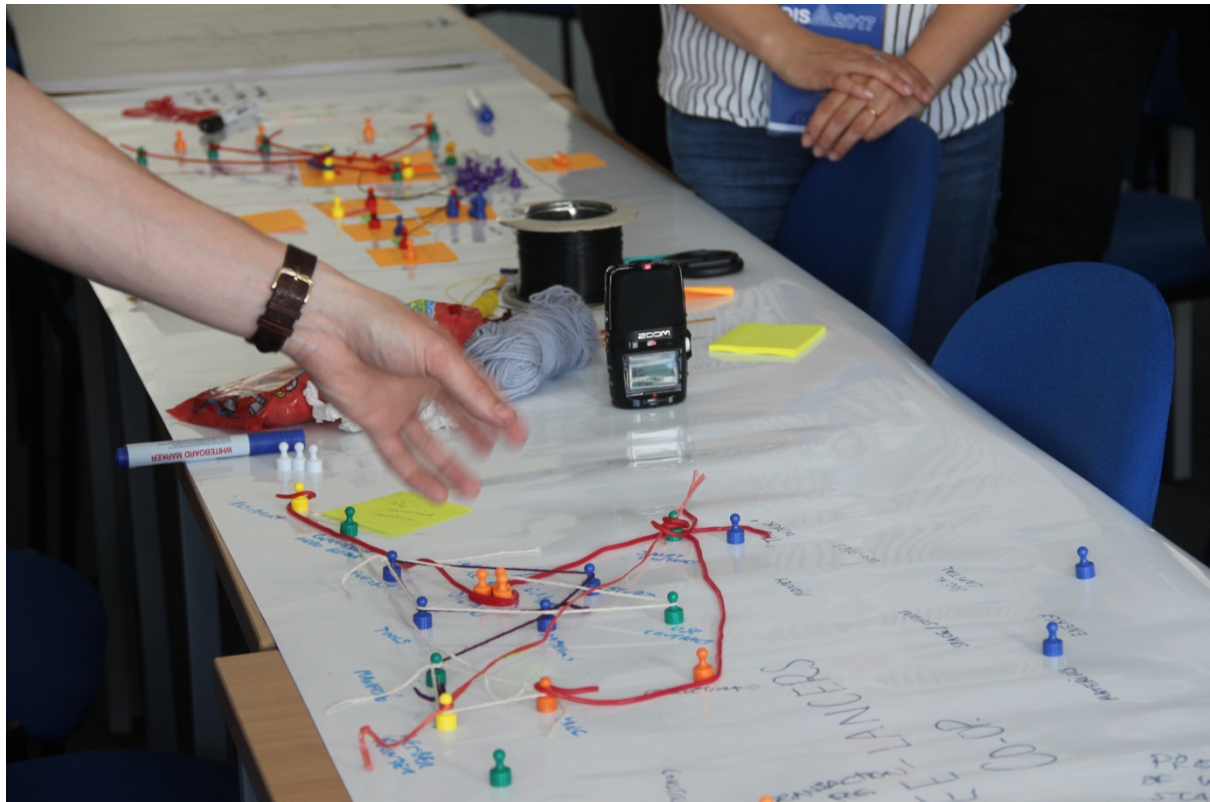


**Figure 6:** Mapping of an Internet of autonomous things from wild to domesticated things.

## Reflections

Throughout the workshop the groups mapped and debated the varying stakeholders and relationships in traditional models and distributed systems in the context of their DAO design exploration. Using different-coloured magnets, post it notes, markers and materials allowed for a collaborative design process and mapping of such a complex system. While not every group used the material qualities to represent specific relationships (as initially intended), all groups chose a variety of colours or materials to differentiate types of relationships and interactions. The developed mappings of complex distributed systems in the varying contexts offered a valuable conversation point for each group to present not

only their final design but process and debates. The material mappings here are not understood as final or realistic designs of a distributed autonomous system, but are seen as material representation of a shared discussion and collaborative process of potential novel considerations for the design of DAOs (Figure 7).



**Figure 7:** Discussing the results of mapping a distributed system with the wider group.

The mapping activities in the four specific domains raised overarching questions and tensions that remain important issues for future developments of blockchain and distributed ledger technologies relevant for the wider HCI community. These tensions could be categorized into three main themes.

1. *Defining dynamic uses in an immutable system:* Questions around the implementation and use of such programmed distributed systems by humans who are experts at making things work in an unintentional manner to adapt and respond to changing circumstances and contexts. How can DAOs better respond to or incorporate human behaviour? Raising questions of permanence and temporality, the debate ultimately asked how the syntax of smart contracts needs to be adapted to support dynamic contracts responsive to people's needs and the system's continuous functionality.
2. *Resolving disagreement and liability in a programmed system:* The purpose of distributed autonomous systems and smart contracts to replace trust, human decision-making and hackability through an immutable programmed system raised questions in terms of issues of disagreement, liability and ultimately the governance of who has the control and power to dissolve such issues. In other words, how do we design for resolving conflict with the structures of a distributed autonomous system? What rules and structures need to be programmed into a system and who programmes such decisions?
3. *Legal implications for society and programmers:* While we have discussed the tensions in the use and behaviour of DAOs in relation to human behaviour, we have yet to consider the wider societal and legal implications of the idea of future programmed businesses, systems and organizations. When considering the autonomous nature of such a system without one organization or group of people holding any legal responsibility, what are the implications for the design and programming of such smart systems? Questions were raised on the possibility that DAOs may currently be operating in a legal loophole, and asked what new

possibilities and what legal precedents may or should DAOs adhere to. The implications of this may stretch beyond the future digital economy to HCI researchers and developers more broadly, where there is potential for legal responsibilities to fall to the programmer who developed a system rather than its users or stakeholders. This then poses questions around what legal expertise may be required in a future design team working on DAOs.

Overall the workshop and mapping activities fostered a very engaged debate attempting to understand the future social, economic and environmental implications of the design of such distributed autonomous systems, questioning who will benefit from an immutable autonomous system burdened with human flaws and technological immutability and if it may ultimately become a more controlling system than a liberating one.

### Acknowledgements

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